



**UNIVERSITI PUTRA MALAYSIA**

**ASSESSMENT OF AN ACRYLIC POLYMER ON THE  
PROPERTIES OF SOIL-CEMENT**

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**ASSESSMENT OF AN ACRYLIC POLYMER ON THE PROPERTIES OF  
SOIL - CEMENT**

**By  
WONG KHIEN NGIE**

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**AUGUST 2003**

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**Faculty: Engineering**

The aim of this study is to compare the performance of Soil Cement with a manufactured polymer in order to examine the physical properties of the stabilized material. The study determine strength, durability, chemical analysis, mineralogical study, microstructural investigation and, computer modeling, CHEVPC.

The laterite soil named Serdang series was used as a fundamental control material for this study. Normal Portland cement and polymer were used as stabilizing agents. Analysis of Variance (ANOVA) design and Tukey test were used for the unconfined compression strength data between the curing periods and between cement and polymer content. The study showed significant difference ( $p < 0.05$ ) in the amount for 8% cement with 10% polymer (SCP810) between the curing periods, between cement content; and between polymer content .

Unconfined compressive strength of SCP810 achieved more than 2.9 MN/m<sup>2</sup> (JKR, 1985) and the durability of wet-dry test shows that the weight loss of SCP810 is 12.9% against 14% of the ACI (1990) as the requirement for the road base material.

Mineralogical study in X-Ray Diffraction (XRD) showed an increase in relative intensity of the coarse grain mineral, Quartz mineral, with addition of the polymer. This findings were confirmed by the micrographs Scanning Electron Microscopy (SEM).

Finally, Layered Elastic computer programme, CHEVPC was used to identify the strain criteria of pavement upon the imposed traffic loading. Then, the strain criteria were used to model the Fatigue Models. The following two models were formulated:

- one in terms of unpaved road for the low and light traffic volume and,
- the other in terms of paved road with different thicknesses of asphalt layer and the upper bound and lower bound of soil cement materials.

The study indicates that the unpaved road is suitable for low and light traffic and the paved road can be constructed as the common road especially in tropical country for example, in Malaysia.

Abstrak tesis dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

## **PENILAIAN POLIMER AKRILIK TERHADAP SIFAT-SIFAT SIMEN-TANAH**

**Oleh**

**WONG KHIEN NGIE**

**OGOS 2003**

**Pengerusi: Azlan Bin Abdul Aziz.**

**Fakulti: Kejuruteraan**

Kajian ini bertujuan untuk menilai keberkesanan simen tanah dengan polimer pembuatan bagi menguji sifat-sifat fizikal untuk kestabilan bahan tersebut. Kajian ini termasuk kekuatan, ketahananlasakan, analisis kimia, kajian mineralogi, kajian mikrostruktur dan, pemodelan komputer, CHEVPC

Tanah laterit yang bernama Siri Serdang digunakan sebagai bahan kawalan asas untuk kajian ini. Simen Portland biasa dan polimer pembuatan digunakan sebagai agen penstabilan. Rekabentuk Varians (ANOVA) dan ujian Tukey digunakan untuk memproses kekuatan mampatan tak terkurung data dari segi tempoh awetan dan kandungan simen dan polimer pembuatan. Kajian menunjukkan bahawa terdapat kesan yang berbeza bagi komposisi 8% simen dengan 10% polimer (SCP810) samada dari segi tempoh awetan, kandungan simen, kandungan polimer ( $p < 0.05$ ).

Kekuatan mampatan tak terkurung bagi SCP810 telah mencapai keputusan melebihi  $2.9 \text{ MN/m}^2$  (JKR, 1985) dan ketahananlasakan (ujian basah-kering) bagi SCP810 telah mencapai 12.9% kehilangan berat kurang daripada 14% (ACI, 1990) yang merupakan syarat keperluan bagi bahan asas jalan.

Kajian mineralogi melalui Belauan Sinar-X (XRD) menunjukkan penambahan dalam keamatan relatif bagi mineral saiz besar, mineral Quartz dengan lebih polimer. Keputusan ini disokong oleh mikrogram mikroskop elektron imbasan (SEM).

Akhirnya, program komputer CHEVPC pula digunakan untuk mengenalpastikan kriteria tegasan bagi turapan semasa dikenakan beban trafik. Kriteria tersebut digunakan pula untuk mengaplikasikan model-model lesu. Terdapat 2 model yang diformulakan seperti berikut:

- satu dalam keadaan tanpa turapan jalan untuk kegunaan isipadu trafik yang rendah dan ringan dan,
- satu lagi berkeadaan turapan jalan dengan ketebalan lapisan asphalt yang berlainan dengan kekuatan bahan tanah simen di bahagian atas and bahagian bawah.

Kajian ini mendapati jalan tanpa turapan lebih sesuai untuk keadaan trafik yang rendah dan ringan. Manakala, jalan turapan boleh dibina sebagai jalan biasa, terutamanya di negara tropikal seperti Malaysia.

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I certify that an Examination Committee met on 26<sup>th</sup> June 2003 to conduct the final examination of Wong Khien Ngie on his Master of Science thesis entitled "Assessment of an Acrylic Polymer on the Properties of Soil-Cement" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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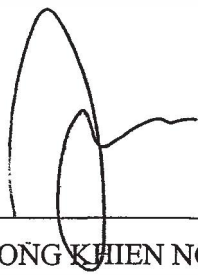
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## DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

  
(WONG KHIEN NGIE)

Date: 25.8.2003

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G75	Unconfined Compressive Strength Test (UCS78-6% Cement-56 days).
G76	Unconfined Compressive Strength Test (UCS16-6% Cement 5% Polymer-7 days).
G77	Unconfined Compressive Strength Test (UCS17-6% Cement 5% Polymer-7 days).
G78	Unconfined Compressive Strength Test (UCS18-6% Cement 5% Polymer-7 days).
G79	Unconfined Compressive Strength Test (UCS46-6% Cement 5% Polymer-7 days).
G80	Unconfined Compressive Strength Test (UCS47-6% Cement 5% Polymer-7 days).
G81	Unconfined Compressive Strength Test (UCS48-6% Cement 5% Polymer-7 days).
G82	Unconfined Compressive Strength Test (UCS136-6% Cement 5% Polymer-14 days).
G83	Unconfined Compressive Strength Test (UCS137-6% Cement 5% Polymer-14 days).
G84	Unconfined Compressive Strength Test (UCS138-6% Cement 5% Polymer-14 days).
G85	Unconfined Compressive Strength Test (UCS91-6% Cement 5% Polymer-28 days).



G86	Unconfined Compressive Strength Test (UCS92-6% Cement 5% Polymer-28 days).
G87	Unconfined Compressive Strength Test (UCS93-6% Cement 5% Polymer-28 days).
G88	Unconfined Compressive Strength Test (UCS94-6% Cement 5% Polymer-56 days).
G89	Unconfined Compressive Strength Test (UCS95-6% Cement 5% Polymer-56 days).
G90	Unconfined Compressive Strength Test (UCS96-6% Cement 5% Polymer-56 days).
G91	Unconfined Compressive Strength Test (UCS25-6% Cement 10% Polymer-7 days).
G92	Unconfined Compressive Strength Test (UCS26-6% Cement 10% Polymer-7 days).
G93	Unconfined Compressive Strength Test (UCS27-6% Cement 10% Polymer-7 days).
G94	Unconfined Compressive Strength Test (UCS55-6% Cement 10% Polymer-7 days).
G95	Unconfined Compressive Strength Test (UCS56-6% Cement 10% Polymer-7 days).
G96	Unconfined Compressive Strength Test (UCS57-6% Cement 10% Polymer-7 days).
G97	Unconfined Compressive Strength Test (UCS145-6% Cement 10% Polymer-14 days).
G98	Unconfined Compressive Strength Test (UCS146-6% Cement 10% Polymer-14 days).
G99	Unconfined Compressive Strength Test (UCS147-6% Cement 10% Polymer-14 days).
G100	Unconfined Compressive Strength Test (UCS109-6% Cement 10% Polymer-28 days).
G101	Unconfined Compressive Strength Test (UCS110-6% Cement 10% Polymer-28 days).
G102	Unconfined Compressive Strength Test (UCS111-6% Cement 10% Polymer-28 days).
G103	Unconfined Compressive Strength Test (UCS112-6% Cement 10% Polymer-56 days).
G104	Unconfined Compressive Strength Test (UCS113-6% Cement 10% Polymer-56 days).
G105	Unconfined Compressive Strength Test (UCS114-6% Cement 10% Polymer-56 days).
G106	Unconfined Compressive Strength Test (UCS10-8% Cement -7 days).
G107	Unconfined Compressive Strength Test (UCS11-8% Cement -7 days).
G108	Unconfined Compressive Strength Test (UCS12-8% Cement -7 days).



G109	Unconfined Compressive Strength Test (UCS40-8% Cement -7 days).
G110	Unconfined Compressive Strength Test (UCS41-8% Cement -7 days).
G111	Unconfined Compressive Strength Test (UCS42-8% Cement -7 days).
G112	Unconfined Compressive Strength Test (UCS130-8% Cement -14 days).
G113	Unconfined Compressive Strength Test (UCS131-8% Cement -14 days).
G114	Unconfined Compressive Strength Test (UCS132-8% Cement -14 days).
G115	Unconfined Compressive Strength Test (UCS80-8% Cement -28 days).
G116	Unconfined Compressive Strength Test (UCS81-8% Cement -28 days).
G117	Unconfined Compressive Strength Test (UCS82-8% Cement -28 days).
G118	Unconfined Compressive Strength Test (UCS83-8% Cement -56 days).
G119	Unconfined Compressive Strength Test (UCS84-8% Cement -56 days).
G120	Unconfined Compressive Strength Test (UCS85-8% Cement -56 days).
G121	Unconfined Compressive Strength Test (UCS19-8% Cement 5% Polymer-7 days).
G122	Unconfined Compressive Strength Test (UCS20-8% Cement 5% Polymer-7 days).
G123	Unconfined Compressive Strength Test (UCS21-8% Cement 5% Polymer-7 days).
G124	Unconfined Compressive Strength Test (UCS49-8% Cement 5% Polymer-7 days).
G125	Unconfined Compressive Strength Test (UCS50-8% Cement 5% Polymer-7 days).
G126	Unconfined Compressive Strength Test (UCS51-8% Cement 5% Polymer-7 days).
G127	Unconfined Compressive Strength Test (UCS139-8% Cement 5% Polymer-14 days).
G128	Unconfined Compressive Strength Test (UCS140-8% Cement 5% Polymer-14 days).
G129	Unconfined Compressive Strength Test (UCS141-8% Cement 5% Polymer-14 days).
G130	Unconfined Compressive Strength Test (UCS97-8% Cement 5% Polymer-28 days).
G131	Unconfined Compressive Strength Test (UCS98-8% Cement 5% Polymer-28 days).

